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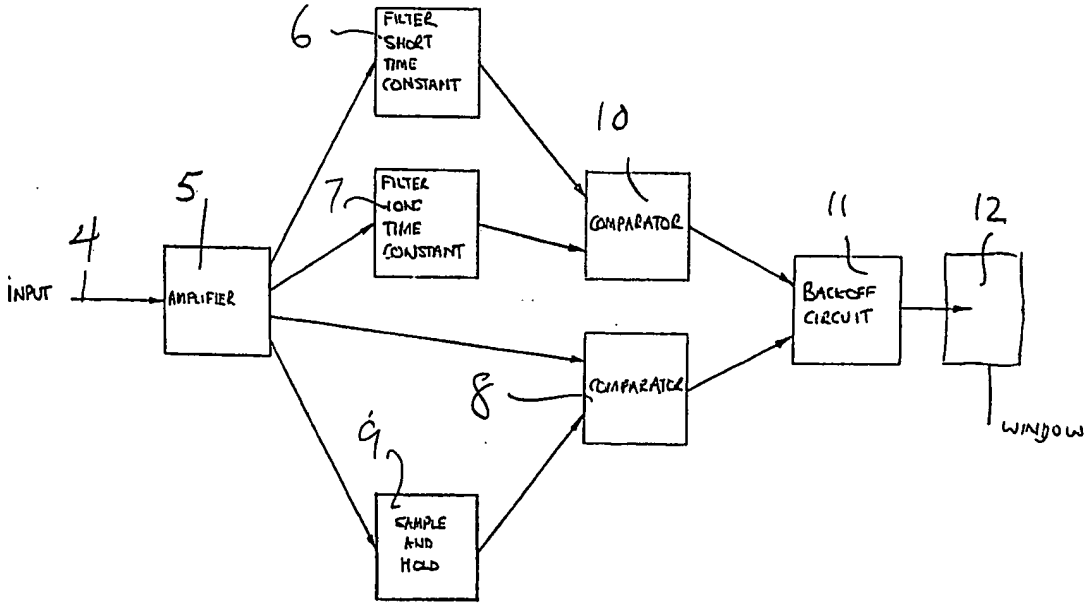
(54) Title: A MOTOR REVERSE SYSTEM



(57) Abstract

A motor reverse system for a motor driven vehicle closure member such as a window comprises filters (6 and 7), comparators (8 and 10), a sample and hold circuit (9) and a backoff circuit (11). The backoff circuit is activated to reverse the motor through a further circuit (12) in two modes of operation. In the first mode, activation occurs when the signal in the motor exceeds that from the sample and hold circuit produced by storing the peak stall current on motor switch on. In the second mode, activation occurs when the output from the filters cross over. The first and second modes correspond to resistance to member closure due to the presence of a soft and hard obstacle respectively.

A MOTOR REVERSE SYSTEM

The present invention relates to a motor reverse system.

The system is particularly, but not exclusively, applicable to closure members such as motor driven doors, windows and sunroofs.

Reverse mechanisms for motor driven automobile window back-off are already known but such mechanisms can impart an unacceptable force to a trapped limb, for example, and may be susceptible to wear in the mechanism during its life affecting operation.

According to the present invention, there is provided a motor reverse system comprising means for sensing the current in the motor to which the system is in use connected, first and second means for sensing resistance to the motion of an object being driven by the motor, said first means comprising a peak current detector for determining current instantaneously drawn by the motor or switch on, comparator means for comparing the peak current detected with the actual motor current value during normal operation, a backoff circuit arranged to operate when the actual motor current equals or exceeds the peak current, said second means comprising filter means arranged to

provides two variables from the motor current one of which responds faster than the other to rates of change of motor current whereby if the motor slows and the rate of change of motor current is sufficient such that said one variable crosses said other variable, the backoff circuit operates.

In mathematical terms, the said one variable (Iinst) is less than the said other variable (Inom) by a variable K where K = Inom - X% Iinst and the backoff circuit operates when

$$\frac{d\ Iinst}{dt} > K > \frac{d\ Inom}{dt}$$

The "backoff" function can be implemented in a number of ways

When the backoff circuit operates the current to the motor is reversed for a time.

In a preferred embodiment of the invention, the current in the motor is sensed by a current sensing track. This track forms in conjunction with the motor a potential divider from which a signal is fed to an amplifier. The output from the amplifier is fed directly and simultaneously to the input of the filter means and sample and hold means. In a first operating mode for an automobile window wind up mechanism, the sample and hold means store the peak stall

current on motor switch on. This may vary depending on the mechanical condition of the mechanism and the automobile battery condition. If that stored signal is subsequently reached indicating a soft obstacle, a signal to activate the backoff means and associated further circuit to back off the window by a nominal amount. The window can then only be moved by switching the normal motor switch on again (either up or down).In a second operating mode, the other variable tracks the first mentioned variable. When a hard obstacle is encountered by the window, the slower reacting variable can no longer keep up with the other variable and the outputs from the two crossover. This is detected and the back off system activated as before. A limit switch deactivates the system as the window approaches the closed position to prevent back off as the window closes.

In order that the invention may be more clearly understood, one embodiment thereof will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 shows a circuit arrangement for measuring a window winder motor current consumption,

Figure 2 shows a block circuit diagram of an arrangement for controlling a backoff for the motor of Figure 1,

Figure 3 shows variation of current with time for the motor of Figures 1 and 2 for a first given operating condition.

Figure 4 shows variation of current with time for the motor of Figures 1 and 2 for a second given operating condition.

Figure 5 shows variation of filter outputs with time in circuit of Figure 1 for the second operating condition of Figure 4. and

Figure 6 shows a partial, closed position, view of a window to be driven by the motor of Figure 1 and 2.

Referring to Figures 1 and 2, a window winder motor 1, draws current in operation from the usual 12v battery supply 2 of the vehicle. This current is monitored using a current sensing track 3 disposed in this supply circuit. The motor 1 and track 3 create a voltage divider and the output 4 from this divider representing the current drawn by the motor forms the input to an amplifier 5.

The output from the amplifier is fed to a low pass filter 6 having a short time constant, a low pass filter 7 having a long time constant, a comparator 8 and a sample and

hold circuit 9. The outputs from the two filters 6 and 7 are fed to a second comparator 10. The first mentioned comparator also receives an input from the sample and hold circuit 9. The outputs from comparators 8 and 10 are fed to a backoff circuit 11 which, in conjunction with a further circuit 9, controls the backoff operation of the window (not shown in Figure 2).

The operation of the system is as follows. The voltage at the output of the amplifier 5 is used in two different ways. As the motor 1 starts up it is effectively in stall condition until it is at working speed. The output voltage on power up will be slightly lower than that at stall. This initial voltage is stored in the sample and hold circuit 9. In the first mode of operation, if the voltage at the output of the amplifier 5 rises above that at the output of the sample and hold circuit indicating a soft obstacle in the way of the window being wound up then the comparator 8 reacts by initiating the backoff circuit 11 to operate the further circuit 12 to stop and reverse the motor 1 for a preset time. As the start up current/voltage is sampled every time the window is wound up the system adjusts automatically to variations in the mechanical elements of the system caused by wear and tear and to battery condition.

Motor current I variation with time t during this operation is shown in Figure 3. As the motor runs up to

speed, current rises rapidly from point A to point B producing a start up current peak B from which, during normal operation, the current falls back to level C. When the obstacle is encountered current begins to rise again until it exceeds the stored start up peak level B when the motor is reversed by reversing the current for a preset time. The reversal point is shown at D and the reverse current at E.

When the motor 1 is in reverse, the circuits which detect motor stall are deactivated. The backoff circuit and the window will not operate again until the switch controlling the window is released, and another signal is given via the motor switch (either up or down).

The output of the amplifier 5 is also fed into the two low pass filters 6 and 7. Filter 6 is fast reacting and is used mainly to rid the input signal of high frequency noise generated by the motor 1. This signal is then reduced by a certain percentage. Filter 7 is an integrating filter which tracks the output of the filter 6 with a delay due to the longer time constant. If the level of current taken by the motor rises slowly the output from filter 7 can track the output from filter 6. If the output from filter 6 rises at a greater rate, suggesting an obstruction, the output from filter 7 cannot keep up. The output from filter 6 crosses the output from filter 7. This condition is shown

graphically in Figure 5, the output from filter 6 being referenced F6, that from filter 7 being referenced F7 and the crossover point CP. F6 and F7 are both plots against time. The plot of motor current against time for this mode of operation is shown in Figure 4. This is similar to that of Figure 3. Window wind up begins at point G, and current rises rapidly to point H. Normally winding takes place until point I when a fast rate of change indicates a hard obstacle. The current at this point is at a much lower level than that at H which is the stall position which indicates that the rate of change of current demand has increased sufficiently to activate the window back off circuit 11. Operation of this circuit 11 and further circuit 12 is as before and as before the window will not operate after backoff until the switch is released and pressed again.

Referring to Figure 6, to prevent the backoff circuit operating when the window 19 reaches the normally closed position, a limit switch 20 is disposed for operation by the window just before the window hits the end stop in the window frame 21. Operation of the switch 20 sends a signal to deactivate the input to the backoff circuitry allowing the window to close without backing off. It will be noted that the position of the switch 20 is such that no significant gap is left to allow anything to be caught in the window.

The above arrangement enables different types of obstacles to normal window closure to be catered for and also accommodates changes due to wear and tear and battery condition.

It will be appreciated that the above embodiment has been described by way of example only and that many variations are possible without departing from the scope of the invention. Although described in relation to a window wind up motor, the back off arrangement could be used in any circumstance where the normal operation of a motor needs to be reversed to deal with an abnormal condition such as an obstacle. The arrangement may be implemented in software as well as hardware or a combination of the two.

CLAIMS

1. A motor reverse system comprising means for sensing the current in the motor to which the system is in use connected, first and second means for sensing resistance to the motion of an object being driven by the motor, said first means comprising a peak current detector for determining current instantaneously drawn by the motor or switch on, comparator means for comparing the peak current detected with the actual motor current value during normal operation, a backoff circuit arranged to operate when the actual motor current equals or exceeds the peak current, said second means comprising filter means arranged to provides two variables from the motor current one of which responds faster than the other to rates of change of motor current whereby if the motor slows and the rate of change of motor current is sufficient such that said one variable crosses said other variable, the backoff circuit operates.

2. A motor reverse system as claimed in claim 1, in which when the backoff circuit operates the current to the motor is reversed for a time.

3. A motor reverse system as claimed in claim 1 or 2, in which the means for sensing comprise a current sensing track.

4. A motor reverse system as claimed in claim 3, in which the track forms in conjunction with the motor a potential divider from which, in operation a signal is fed to an amplifier.

5. A motor reverse system as claimed in claim 4, in which the output from the amplifier is connected to the input to the filter means and to sample and hold means.

6. A motor reverse system as claimed in claim 5, in which the sample and hold means are operative to store the peak stall current on motor switch on.

7. A motor reverse system as claimed in claim 6, in which, the comparator means is operative to compare the voltage at the output from the amplifier with the voltage at the output of the sample and hold means and to activate the backoff circuit when the amplifier output voltage exceeds the output voltage of the sample and hold circuit in a first mode of operation of the system.

8. A motor reverse system as claimed in claim 7, in which a further circuit is provided for stopping and reversing the motor when the backoff circuit is activated.

9. A motor reverse system as claimed in any preceding claim, in which the filter means comprises a first fast

reacting filter and a second integrating filter operative to track the output of the first filter with a delay whereby in operation to provide the two variables from the motor current.

10. A motor reverse system as claimed in any preceding claim, in which a limit switch is associated with the backoff circuit operative to deactivate the input to the backoff circuit when an element driven by the motor reaches a predetermined position.

11. A closure system for a vehicle comprising a closure member, a motor for driving the closure member between open and closed positions and a motor reverse system for controlling the motor as claimed in any preceding claim.

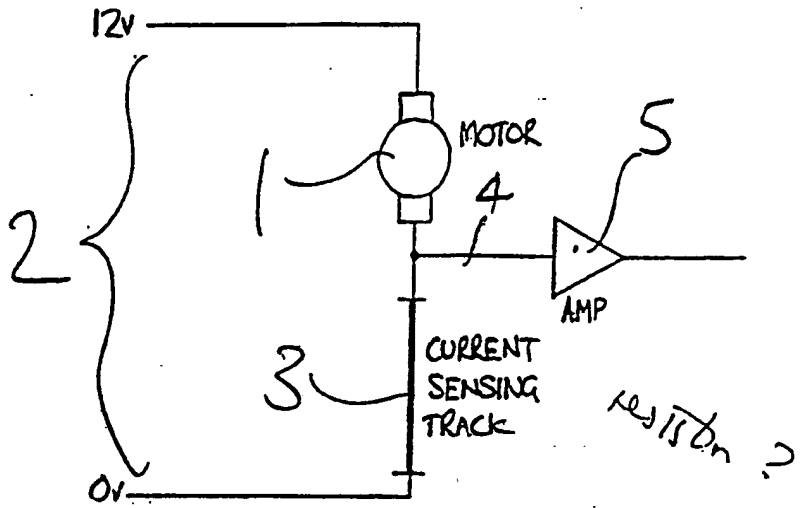

12v
MOTOR
1
2
4
5
AMP
3
CURRENT
SENSING
TRACK
0v

FIG 1.

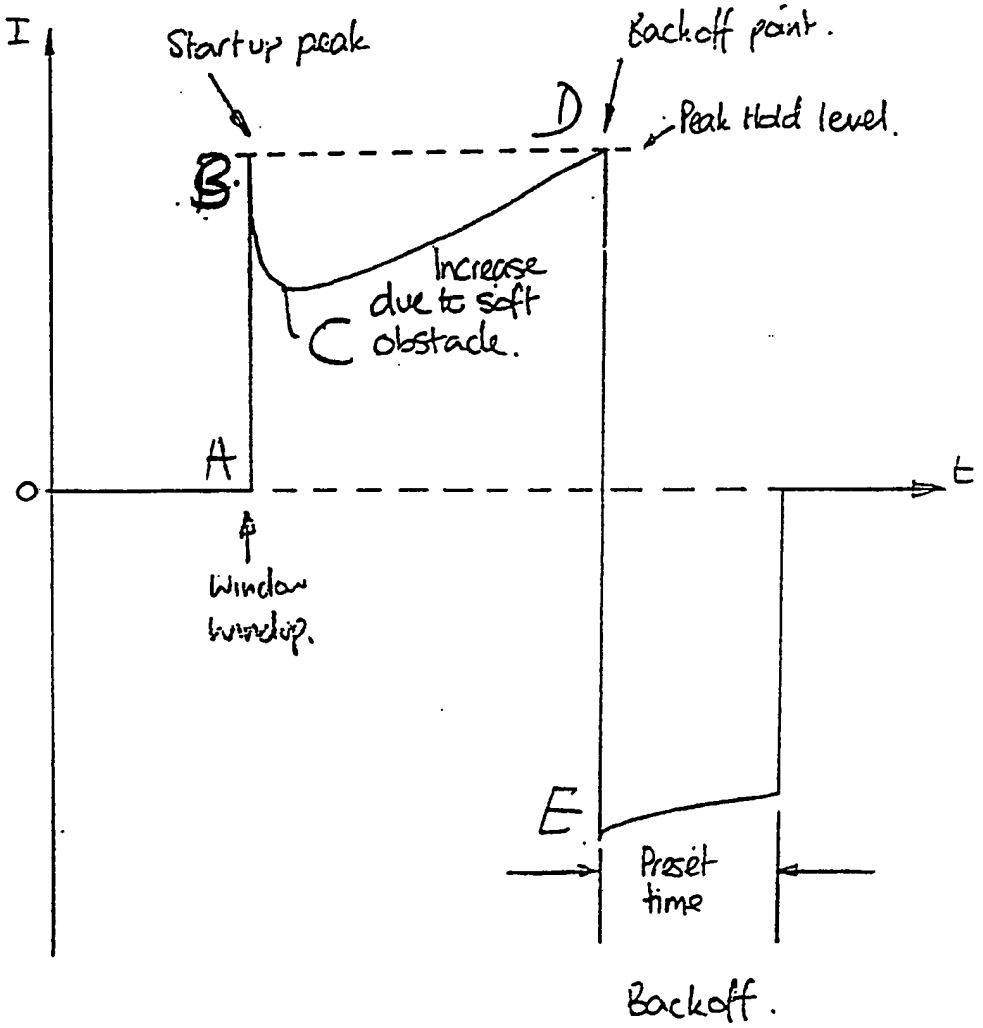

I
Startup peak
Backoff point.
D
Peak Hold level.
B
Increase
due to soft
C
obstacle.
A
0
t
Window
windup.
E
Preset
time
Backoff.

FIG 3.

Block Diagram;

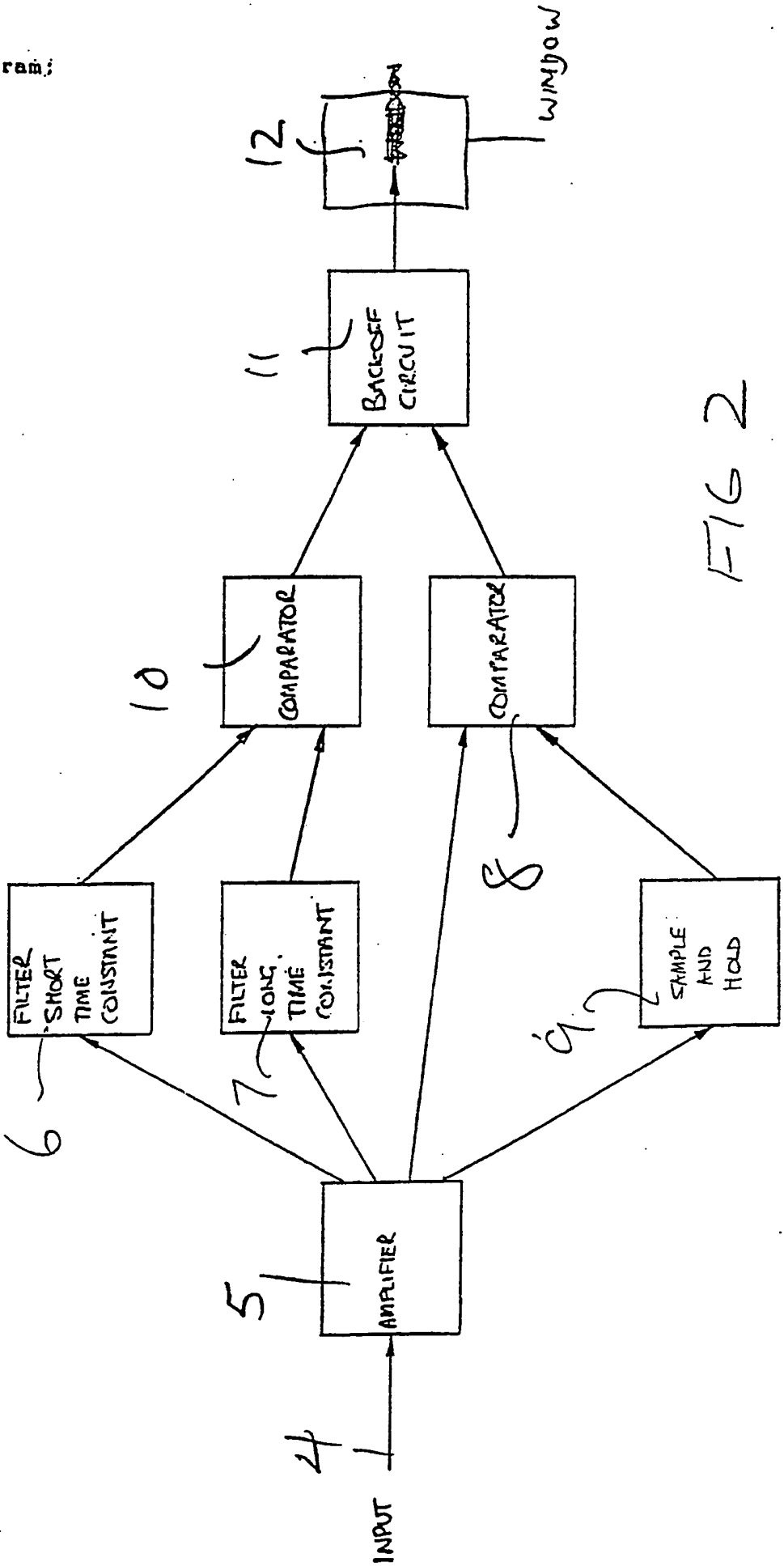


FIG 2

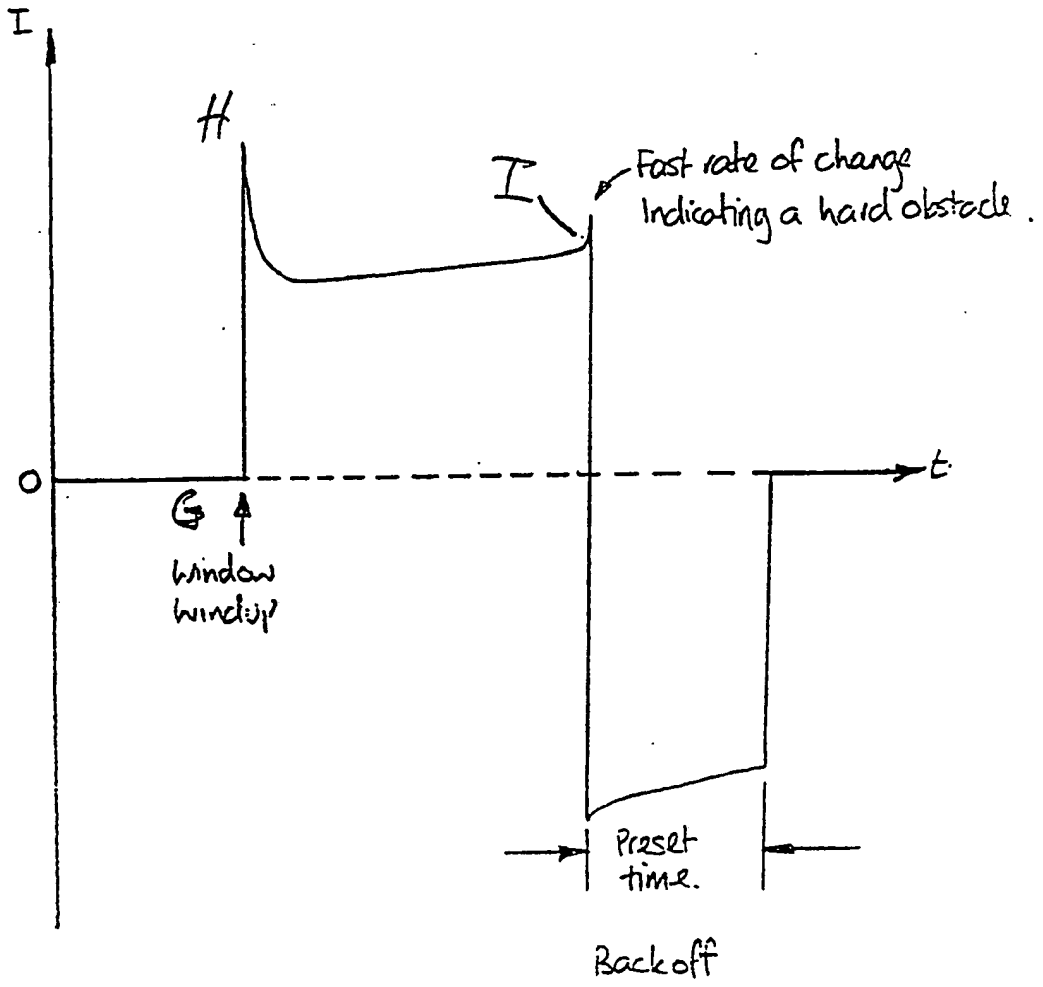

I
H
I
Fast rate of change
Indicating a hard obstacle.
0
t
G
Window
Windup
Preset
time.
Backoff

FIG 4

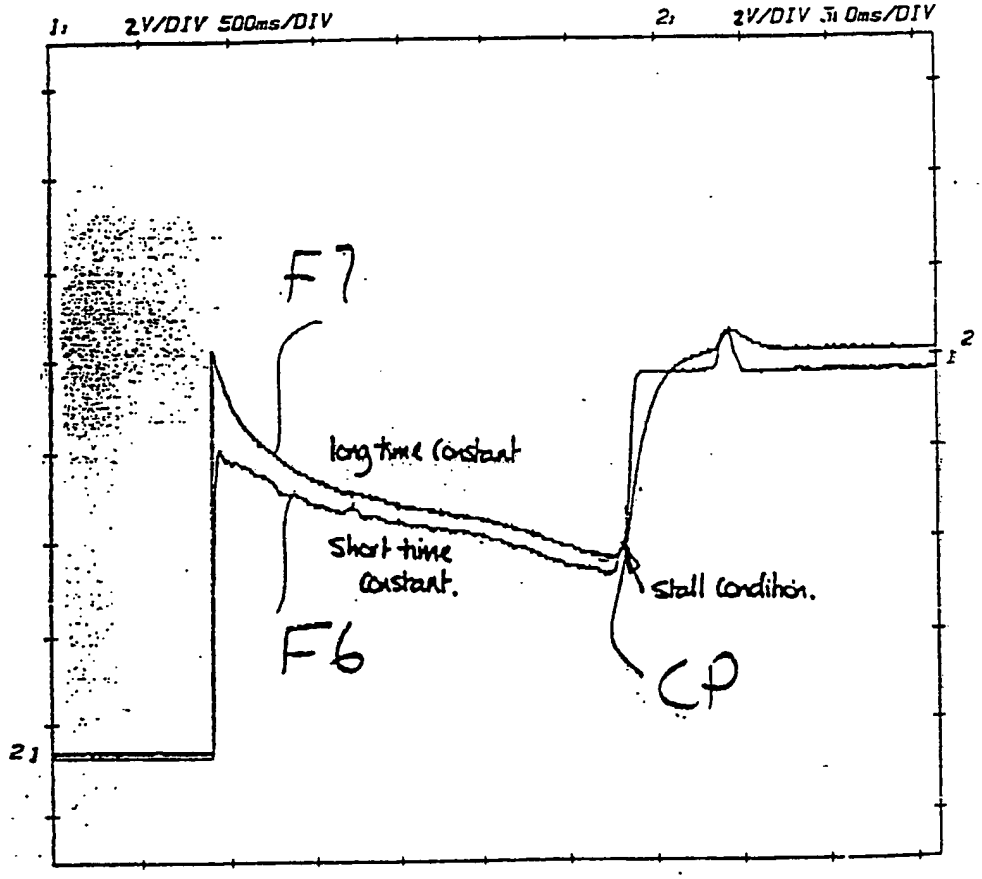

1: 2V/DIV 500ms/DIV
2: 2V/DIV 500ms/DIV
F7
long time constant
short time constant.
F6
stall condition.
CP
2
1
2

FIG. 5

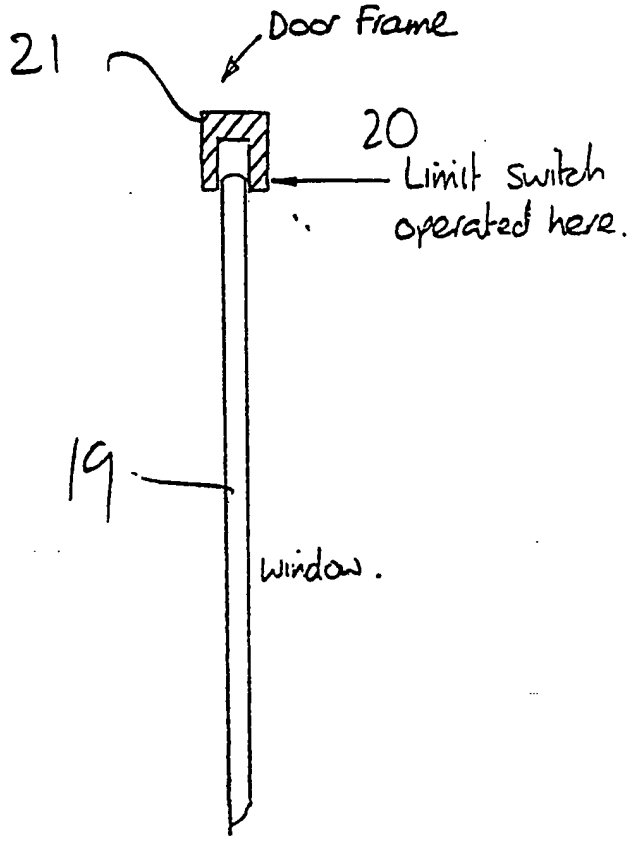


FIG 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 92/00862

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 E05F15/00; H02P7/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	E05F ; H02P

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	DE,A,3 832 941 (ALPS ELECTRIC CO.) 13 April 1989 see the whole document	1-3,10, 11
A	US,A,4 581 900 (M.M. LOWE ET AL) 15 April 1986 see abstract; figures 1,5	1
A	EP,A,0 267 064 (DAV) 11 May 1988 see abstract; figure 3	1,11
A	DE,A,3 532 078 (FUJITSU LTD) 17 April 1986 see abstract; figure 1	1,11
A	DE,A,3 332 813 (KUSTER & CO GMBH) 28 March 1985 see abstract; figures 1,3	1,11

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
12 AUGUST 1992	28.08.92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	BEYER F.

1

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9200862 SA 59350

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 12/08/92
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A-3832941	13-04-89	JP-A- 1089984	05-04-89
		US-A- 4900994	13-02-90
US-A-4581900	15-04-86	CA-A- 1225716	18-08-87
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		JP-A- 61069390	09-04-86
		JP-A- 61069391	09-04-86
		JP-A- 61078984	22-04-86
		CA-A- 1264802	23-01-90
		US-A- 4641067	03-02-87
DE-A-3332813	28-03-85	None	